ARTICLE VII
INFRASTRUCTURE IMPROVEMENTS

This article establishes standards for the design of improvements for all land uses as a part of subdivisions or other developments within the county. Improvements for primary and other infrastructure include stormwater drainage systems, sanitary sewer systems, water systems, streets, driveways and sidewalks, utilities and other related systems required. All plans for improvements must be designed by a Registered Professional Engineer, approved by the planning commission and reviewed, inspected by the planning commission's engineer and/or other regulatory agencies, where applicable, in accord with provisions of these regulations.

SECTION 7.0 STORM WATER DRAINAGE SYSTEMS

A. GENERAL

1 This section establishes the criteria, methodology, minimum standards and specifications for design of all components of a storm drainage systems. Such components may include the following systems: a) open systems (i.e. rivers, streams, creeks, channels, linings, side ditches, inlets, street curb and gutter, etc.); b) closed systems (i.e. bridges, box culverts, sewer pipe, manholes, junction boxes, etc.); c) impoundments (i.e. lakes, ponds, detention/retention basins, underground vaults, etc.); or d) combinations of open and closed systems or impoundments as an internal part of the storm drainage system.

2. Design criteria for subdivision development shall apply to all storm drainage systems within areas shown on a Preliminary Plat. Other developments processed through zoning-ordinance including Site Plans for all land uses shall also apply. Such designs must include local systems impacted by "direct runoff" from the site and extra-sized systems for "through runoff" stormwater drainage emanating from other developed or undeveloped land uses within the drainage area.

3. Any development adjacent to other facilities (i.e., floodplain, streams, highways, county roads, etc.) under the jurisdiction of federal, state and/or local governmental agencies must be "Permitted" by these agencies prior to final approval by the planning commission or its engineer for construction. In these cases, the following approvals must be obtained, where applicable:

- Application for Permit to construct across or along a Stream (if applicable) from the Commonwealth of Kentucky, Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water - Floodplain Management Section - Water Resources Branch;

- Application for Water Quality Certification (if applicable) from the Commonwealth of Kentucky, Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water - Water Quality Branch;

  Application for Storm Drainage System Encroachment Permit (if applicable) from the Commonwealth of Kentucky, Department for Highways, along State Highways from local district and/or Frankfort offices;

  Application for Storm Drainage System, Encroachment Permit (if applicable) from the County Road Department along County Roads from the local office;

B. HYDROLOGY

1 Rainfall Probability and Recurrence Interval

The exact time of occurrence of flooding from rainfall at a given magnitude cannot be accurately predetermined. However, statistically the probability of occurrence of a storm is one means of quantifying flood severity. For example, a one (1) percent storm is a storm that has a one (1) percent probability of being reached or exceeded in a given year.

Flood severity may also be expressed in terms of recurrence interval stated in years. Recurrence Interval of a storm relates inversely to its probability. For example, a 1 percent storm is one that will be reached or exceeded on the average of once every 100 years. Therefore, design of all storm drainage systems may be based upon one or more of the following design storms:

- 2 - Year Recurrence Interval Storm - 50 percent probability to occur in any year.
- 10 - Year Recurrence Interval Storm -10 percent probability to occur in any year.
- 25 - Year Recurrence Interval Storm - 4 percent probability to occur in any year.
- 50 - Year Recurrence Interval Storm - 2 percent probability to occur in any year.
- 100 - Year Recurrence Interval Storm - 1 percent probability to occur in any year.

2. Design Storms

Most rainfall - runoff methods require selection of a design storm having a specified recurrence interval and a duration. Selection of design storms is then bases for all runoff calculations and facility design. The following design storms shall be used, where applicable:

The 10 - Year Storm shall be used for all low and high density residential, commercial, industrial uses and public facilities. Local drainage systems (i.e., open channels, inlets and closed pipe systems, etc.) for "direct runoff" shall be designed to collect and transport the post development rate of runoff unless damaging flooding or surcharging occur when higher recurrence interval storms are selected subject to review;

The 25 - year Storm shall be used for all sewer systems designed for 10 Year as a Check Storm to further ensure against damaging flooding or surcharging where public access emergencies or severe property losses will occur;

The 2, 10 and 50 Year Storm shall be used to limit post - development discharges for detention basin multi - storage discharge control structures;

The 100 - Year Storm shall be used in comparison with established flood elevations from property owners, observations, KDOT drainage folder data, FEMA maps and other viable records to minimize the impacts of flooding and stormwater. In areas of the county covered by a Flood Insurance Study, detailed mapping including elevations, floodplain limits and cross - sections is available at planning commission offices. For areas not covered by a detailed study which may be included within documented approximations for drainage areas larger than 1 square mile (640 acres), hydraulic profiles may be available from the Natural Resources and Environmental Protection Cabinet, Department of Environmental Protection, Division of Water - Floodplain Management Section - Water Resources Branch with field work or existing mapping, as submitted. However, in all cases not covered by such studies, the design engineer is responsible determining 100 - Year Peak Discharge (0) by acceptable engineering regional methods or other methods as described within these regulations.

3. Time of Concentration

a. Rainfall - runoff methods require determination of the time of concentration. Time of concentration is defined as the time required for surface runoff to flow from the most hydraulically remote point in a drainage area, watershed or subwatershed to the outlet. Time of concentration (Tc) is the sum of the flow time for sheet or overland flow, which occurs in headwater areas; the flow time for shallow

concentrated flow, which occurs immediately downstream of overland flow; and the flow time for open channel or sewer flow, which tends to occur in the lower reaches of a watershed tributary area.

b. The United States Natural Resources (formerly Soil) Conservation Service SCS TR55 method described later is one effective approach for determination of Time of Concentration (Tc) because it provides a means of estimating sheet or overland flow time and shallow concentrated flow time as a function of readily quantifiable parameters such as slope and type of land surface. However, if a watershed has a Tc less than 0.1 hours or 6 minutes, SCS TR55 cannot be used.

c. Other alternative methods for determining Time of Concentration (See Section 5.b.(3) may also be used as part of The Rational Method described later. In this method, time of concentration is the critical time period used to determine average rainfall intensity from IDF (intensity Duration - Frequency) curves. Inasmuch as rainfall is a random event, it is possible that such an event could have a duration equal to the time of concentration of a watershed. However, it is much more likely that the total duration of a storm will be longer than the time of concentration used in the Rational Method.

4. Runoff Method Selection Process

The runoff method selected for design of all drainage systems is dependent upon various parameters or factors within each watershed area impacted. In order to properly quantify the magnitude and impact of stormwater runoff discharges, factors used include: a) location of major streams or channels; b) size of overall and separate drainage areas; c) detention/retention storage or volume requirements; and d) the impacts of local and through drainage systems. The proper method selected shall be determined from the following:

a. Where land development boundaries are contiguous or are within a detailed Flood Insurance Study or contain reaches, streams or channels having drainage areas larger than (200 acres), the method of runoff calculation shall be an acceptable regional method for determining Peak Discharges and Profiles, which may include the Corps of Engineers' Hydraulic Engineering Center HEC - I or HEC - 2 (water surface profiling only) or the Soil Conservation SCS TR55 Methods. HEC-2 is used to compute water surface elevations not watershed discharges. However, Flood Insurance Studies (FIS) used in conjunction with a HEC-2 analysis do provide valuable hydrologic information such as the 100-Year peak watershed discharges. FIS(S) typically use USGS Regression equations to develop the 100-Year discharges. The SCS TR55 procedure, which may also be used for drainage areas less than 200 acres, is described in Subsection B.5.a. However, if a watershed has a Tc less than 0.1 hours or 6

minutes, SCS TR55

cannot be used.

In the latter case the Rational Method should be used. However, it should be noted that use of the Rational Method for large watershed areas may introduce some large significant error.

b. Where a land development's "local" drainage area contributes direct runoff and a storage volume design is required, the method of runoff calculation may be the SCS TR55 or the Modified Rational Method (MRM) procedures as described within Subsections B.5.a or B.5-c-, respectively; or

c. Where a storage volume design is required, other methods (using computer software) may be utilized; but, only if such methods have been accepted by the engineering community as an approved equal, and computed results are within a reasonable comparison to other methods as specified. It shall be within the planning commission's authority to question/require alternate methods/runs as a check to ensure compliance within minimum standards, as regulated herein, where applicable; and

d. Where a land development's drainage area contributes "local runoff" and/or "through runoff", the method of runoff calculation for determining peak discharge ((D) shall be the Rational Method procedure as described within Subsection B.5.b. The SCS TR 55 Method described in Subsection B.5.a may also be utilized, but, only if adequate reference to this method is used and submitted.

e. Where a storage volume design is required, pre and post development discharges shall be generated using the same methodology. Any approach which employs the Rational Method to determine pre- development peak discharges and TR55 or another method to determine post development runoff shall be prohibited.

5. Runoff Calculation Methods

This section describes recommended procedures for calculating rainfall - runoff generated within a watershed. Correct usage of the procedures should result in the best available estimate of pre - development and post-development runoff. Their use will also provide the consistency of results necessary when applied to all development plans throughout the county.

Assumption is made herein that design engineers involved with hydrologic and hydraulic analyses resulting in preparation of storm drainage plans have adequate qualifications for the recommended procedures. Therefore, step-by step methods of calculation are reserved for the design engineer with associated documents as referenced herein subject to review/approval by the planning commission. The information provided makes an attempt to streamline or assimilate the runoff calculations process with the regional aspects of the Comprehensive Plan as updated.

Soil Conservation Service Methods include SCS TR 20, TR55 and Hydrograph Development Methods. Detailed descriptions, example calculation worksheets and/or reference to computer programs are available in the following referenced manuals/documents:

Project Formulation - Hydrology, Technical Release No. 20 User's Manual;

Urban Hydrology for Small Watersheds, Technical Release No. 55;

National Engineering Handbook Chapter 16 Section 4 - Hydrology (NEH - 4) (SCS 1985).

a. Soil Conservation Service SCS TR 55 Method (1975, 1986 or as amended).

The SCS TR55 method calculates peak discharge for one or more recurrence intervals. Given a specified recurrence interval, this method can calculate corresponding peak discharge and with the addition of an allowable peak outflow discharge can be used to calculate the required volume of a detention/retention facility. The TR55 method can also be used to develop runoff hydrographs for subbasins in a watershed and to combine them as they move through the stream system.

Application of TR55 includes the following hydraulic analyses: (a) Runoff depths; (b) Time of Concentration/Travel Times; (c) Peak Discharge; and (d) Detention/Retention Storage Volume.

(1) Runoff Depths

The highest peak discharges from small watersheds are usually caused by intense brief rainfalls that may occur as distinct events or as part of a longer storm. For the size of drainage areas by SCS Methods, a storm period of 24 hours was chosen for the rainfall distribution. The intensity of rainfall varies considerably during a storm as well as over geographic regions. To represent various regions SCS developed four (4) synthetic 24 - hour rainfall distributions from available National Weather Service local storm data. Type II, the most intense short duration rainfall, is representative of Northern Kentucky.

In the SCS TR55 method, rainfall depths for recurrence intervals and steady storm durations are available from Exhibit 7-1. These values, applicable to Kentucky, have been derived from SCS manuals and the document entitled Rainfall Frequency Values for Kentucky - Engineering Memorandum No. 2 April 30, 1971; Revised June 1, 1979, published by the Department for Natural Resources and Environmental Protection, Bureau of Natural Resources, Division of Water Resources.

A critical parameter in Exhibit 7-1 is the Time of Concentration (Tc), the time it takes for runoff to travel to a point from the most hydraulically

remote point in the watershed. Normally, a rainfall duration equal to or greater than (Tc) is used. Therefore, the rainfall distribution was designed to contain the intensity of any duration of rainfall for the recurrence interval of the event chosen. That is, for correlation within Exhibit 7-1, when the 1 0 - Year, 24 - hour storm is used, in the TR55 Method, the most intense hour may approximate the 10 - Year, 1 - hour rainfall depth.

(2) Runoff Curve Numbers (RCN)

The Runoff Curve Number (RCN) is a coefficient which converts rainfall depth to surface runoff depth. Exhibits 7 -2 and 7 - 3 provide for the estimation of the RCN as a function of land use, hydrologic soil group including residential uses by average lot size and width. SCS TR55 also accommodates other various possible complexities including: a) determining the RCN for impervious percentages not listed; b) setting the RCN when all of the impervious surface is not directly connected to the drainage system; and c) determining the RCN when the drainage area contains more than one land use - hydrologic soil group combination. Composite RCN values obtained from Exhibit 7-4 should be applied only in cases where land uses are mostly homogeneous. For detention basin design within any land use designation, credits are prohibited. Post development RCN(S) may not be less than pre - development RCN(s).

(3) Land Use and Hydrologic Soil Groups (HSG)

Soils are classified into hydrologic soil groups (HSG). These groups are: Group A (well drained sandy loams); Group B (moderately drained sandy loams); Group C (poorly drained sandy clays), Group D (very poorly drained clays); and, a Group identified as Unclassified Urban Area (extremely well drained soils). It should be note d that the later group may not be representation of actual RCN(s). Soil Groups indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. For the convenience of TR55 users, the Urban Hydrology Manual lists HSG classifications for soil within the county.

(4) Antecedent Runoff Condition

The index of runoff potential before a storm event is the Antecedent Runoff Condition (ARC). ARC is an attempt to account for the variation in RCN at a site from storm to storm. The RCN(S) listed in Exhibits 7 - 2 and 7 - 3 are for the average ARC (i.e. Ia = 0.2S or 0.2 times potential maximum soil retention after runoff begins where S = $\frac{1000}{}$ minus 10. Tabular values are used primarily for RCN design applications. Refer to the National Engineering Handbook (NEH - 4) for more detailed discussions of storm to storm variation and a demonstration of upper and lowering enveloping curves, where applicable.

(5) Urban Impervious Area Modifications

The percentage of impervious area and the means of conveying runoff from impervious areas to the drainage system should be considered in computing RCN for urban areas. Do the impervious areas connect directly to the drainage systems, or do they outlet onto lawns or other previous areas where infiltration can occur? Further detail is necessary for consideration of connected and unconnected impervious areas. Exhibit 7 - 5 can be used for RCN adjustments for these areas.

Once rainfall depth is determined from Exhibit 7 - 1 and a composite RCN is quantified from Exhibits 7 - 2, 7 - 3, or 7 - 4, a surface runoff depth or volume for a recurrence interval may be determined from Exhibit 7 - 6. Given the depth or volume an equivalency in Acre - Feet may be determined when related to the watershed area.

(6) Time of Concentration and Travel Times

Time of Concentration (Tc) is the sum of Travel Times (Tt) for consecutive flow segments including Sheet Flow, Shallow Concentrated Flow and Open Channels.

Sheet Flow is flow less than 300 feet over plane surfaces usually occurring in the headwater of watersheds. With Sheet Flow, the friction value (Manning's n) is an effective roughness coefficient that includes certain obstacles and transportation of sediment for very shallow depths of about 0.1 feet. Exhibit 7 - 7A lists Manning's "n" values for Sheet Flow on various surface conditions. After a maximum flow length of 300 feet, Sheet Flow usually becomes Shallow Concentrated Flow. The average velocity for this flow can be determined from Exhibit 7 - 8 in which average velocity is a function of watercourse slope and type of channel. The flow time for this segment may be obtained by dividing the length of the flow path by the average velocity.

Open Channels are assumed to begin where surveyed cross - section information has been performed, where channels are visible on aerial photographs, or where blue line streams appear on USGS quadrangle sheets. Exhibit 7-7B lists Manning's "n" values for open channels on various surface conditions. Manning's Equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull elevation.

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed to be zero (0).

(7) Peak Discharge

Rainfall Depth (in inches), the Composite RCN coefficients and total Time of Concentration (Tc - in hours) of a watershed are combined with the

rainfall distribution and subbasin watershed area to obtain Peak Discharge at the outlet.

Part of the rainfall distribution includes Initial Abstraction. Initial Abstraction is the initial portion of a rainfall event (in inches) that is lost to infiltration, etc. before surface runoff begins. The quantity is "abstracted from" or "lost to" runoff by process such as depression storage, infiltration, interception and evaporation. Initial Abstraction (Ia) is obtained as a function of the RCN using the Exhibit 7 - 9. The ratio of Initial Abstraction to the design storm 24 - hour rainfall depth using Exhibit 7 - 10 can be determined.

Time of Concentration (Tc) and the ratio of Initial Abstraction (Ia) to rainfall are used to determine the unit peak discharge for a Type 11 rainfall distribution using Exhibit 7 - 10. Peak discharge is the product of unit peak discharge (units in cubic feet per second per square mile per inch of runoff), the surface runoff (in inches) and the subbasin area (in square miles).

SCS TR55 provides cautions, limitations, etc. and offers guidance on possible complexities including accommodating more than one main stream or drainageway and adjusting for ponds and wetlands scattered around the watershed.

(8) Detention/Retention Storage Volume

Four given or calculated factors are used to determine required storage volume. The first factor is Peak Discharge from the subbasin and therefore the peak flow rate into a potential detention/retention facility just previously determined within Subsection B. 5. a. (7). The second factor is the runoff depth determined within Subsection B. S. a. (1). The third factor is the allowable peak outflow discharge from the detention/retention facility. This factor should approximate pre development conditions. The last factor is the type of rainfall distribution applicable to the subbasin (Type II).

Using Exhibit 7 - 11**,** the ratio of peak outflow discharge to peak inflow discharge and Type II rainfall distribution yields a ratio of storage/runoff volume. Therefore, the required storage volume is the product of this ratio (a decimal) and surface runoff depth or volume (in acre - feet). All that remains is a specific design of the basin. More detail on design follows.

NOTE:

1. The Land Use Plan for each watershed within Grant County anticipates higher percentages of impervious surfaces (when completely developed) that may be reflected in the coefficients listed in Exhibits 7 - 2 and 7 - 3 at pre-developed conditions. The design engineer shall select or calculate runoff coefficients which

reflect actual proposed designs within each site. For subdivisions, the designer may allow pre - existing off site runoff to pass through; but, include direct runoff from a site by using RCN values based upon average percentages of impervious surfaces as listed. For detention basin design within any land use, credits are prohibited. Post - Development RCN(S) may not be less than Pre Development RCN(s).

b. The Rational Method

The Rational Method calculates peak discharge only for drainage areas which do not exceed 200 acres. However. it should be noted that use of the Rational Method for large areas may produce significant error. A widely held misconception about the Rational Method is that the Time of Concentration corresponds to the duration of a storm. Therefore, this method (used directly) cannot be used to calculate the volume of stormwater runoff or develop runoff hydrographs for subbasins in a watershed.

(1) Application of the Rational Method includes the following:
Q = CIA, where
0 = Peak discharge (cubic feet per second)
C = Runoff Coefficient
I = Rainfall intensity (inches per hour)
A = Tributary Area (acres)
Tc = Time of Concentration

(2) Rainfall intensity (I) for recurrence intervals and durations (i.e. Time of Concentration) shall be obtained from Exhibit 7 - 12.

(3) Time of Concentration (Tc) shall be determined by calculating the time of a particle of water to travel from the most hydrologically remote point of the watershed to the inlet, outlet or other point of interest. The shallow concentrated flow portion of the (Tc) may be estimated by using Exhibit 7 - 8, from which average velocity may be determined. At no time shall (Tc) be greater than 30 minutes. Other methods to derive Time of Concentration such as SCS TR55 or Kentucky Transportation Cabinet's Drainage Manual Kinematic Wave for estimating the sum of overland flow and channel flow components to be used will also be acceptable. Any in - pipe or open channel travel should be estimated by Manning's Equation.

Unless otherwise determined by the above methods, Time of Concentration (Tc) may be estimated for the following residential land uses. For single - family residential development with lot sizes less than one (1) acre and all undeveloped areas: Average Slope Range (Flat 7%); Tc = 10 minutes; Slope (7% or greater); Tc = 8 minutes.

For single - family residential development or residential rural estates with lot sizes one (1) acre or greater; slope (Flat - 7%); To = 15 minutes; slope (7% or greater); Tc = 10 minutes. Time of Concentration (Tc) for all land uses other than single - family residential or agricultural uses shall be determined by SCS Methods or Exhibit 7-8.

(4) Runoff Coefficients - The runoff coefficient is the portion of precipitation, expressed as a decimal, that will reach a stormwater inlet, outlet, facility or other point of interest. Runoff coefficients (C) used for all impervious or hard surface areas (i.e., streets, roofs or other flatwork, etc.) shall be C 0.95. In order to establish a uniform standard for existing and/or pre-developed conditions, runoff coefficients (C) used for previous and all other areas within the watershed shall be C = 0.40. Coefficients greater than or less than C = 0.40 for existing and/or pre - developed conditions shall not be used.

Weighted runoff coefficients (C) for various land uses planned for development have been established as listed within Exhibit 7-13. These values are based upon average percentages calculated of imperviousness or hard surfaces (i.e., streets, roofs, or other flatwork, etc.) constructed in present day practices. Runoff coefficients listed shall be used directly when the project site, as designed, includes these percentages of hard surfaces or lot sizes/widths as listed. If the site deviates from the values, as listed, a weighted runoff coefficient (C) shall be calculated and reviewed by the planning commission's duly authorized representative. For single - family residential uses containing a variation of different lot sizes and widths and surface areas, values as listed may be used in a ratio to total area to calculate a weighted runoff coefficient.

NOTE:

1. The Land Use Plan for each watershed within Grant County anticipates higher percentages of impervious surfaces (when completely developed) that may be reflected in the coefficients listed in Exhibit 7 - 13 at pre developed conditions. The designer shall select or calculate runoff coefficients which reflect actual designs within each site. For subdivisions, the designer may allow pre - existing off - site runoff to pass through; but, include direct runoff from a site by using values based upon average percentages of impervious surfaces as listed. Runoff Coefficients (C) range from C=0.40 for previous to C=0.95 for impervious areas. For detention basin design within any land use, credits are prohibited. Post - development C(s) may not be less than pre - development C(s).

C. The Modified Rational Method

The Modified Rational Method (MRM) relies on the same assumptions of the Rational Method. However, this method is available for estimating detention reservoir storage volumes governed by the characteristics of the drainage area

and the maximum allowable outflow rate. This procedure is based upon the following assumptions:

(1) Rainfall intensity (I) for recurrence intervals and durations (i.e. Time of Concentration) may be obtained from Exhibit 7 - 12.

(2) Storms with durations (d) longer than the time of concentration (Tc) for the drainage area produce larger volumes of run - off even though the peak flow rates are reduced.

(3) The inflow hydrograph is in the form of a trapezoid; where peak discharge may be calculated by the Rational Method (Q = CIA), and rising and receding limbs of the inflow hydrograph are = (equal to) or > (greater than) the time of concentration.

(4) The area under the inflow hydrograph represents the total volume of storm runoff and is equal to the peak rate of runoff, 0, multiplied by the storm duration or QT.

NOTE:

1 The Land Use Plan for each watershed within Grant County anticipates higher percentages of impervious surfaces (when completely developed) that may be reflected in the coefficients listed in Exhibit 7 - 13 at pre developed conditions. The designer shall select or calculate runoff coefficients which reflect actual designs within each site. For subdivisions, the designer may allow pre - existing off - site runoff to pass through; but, include direct runoff from a site by using values based upon average percentages of impervious surfaces as. listed. Runoff Coefficients (C) range from C=0.40 for previous to C=0.95 for impervious areas. For detention basin design within any land use, credits are prohibited. Post - development C(s) may not be less than pre development C(s).

C. DESIGN FOR STORM SEWERS

Storm sewer systems are designed to collect and convey stormwater runoff from street inlets, runoff control structures, and other locations where the accumulation of stormwater is undesirable. The objective is to remove runoff from an area fast enough to avoid unacceptable amounts of ponding damage and inconvenience.

1. Design Flows - The method of runoff calculation for determining peak discharge (Q) for a drainage area shall be the Rational Method procedure as described within Subsection B.5.b. The SCS TR 55 Method described in Subsection B.5.a may be utilized; but, only if full computerized data base is used and submitted. Sewer pipe conduits or other facilities must have the capacity to transport the 10 - Year post-development discharge or other design storm required within Subsection B.2. The water surface profile and through system

capacity shall be checked for the 100-Year post-development discharge, where applicable. Additional facility requirements may be found in other portions of Subsection C., where applicable.

2. Time of Concentration - The minimum Time of Concentration (To) for overland flow to the first inlet or structure of any facility shall be eight (8) minutes.

3. Pipe Capacities
Storm sewer pipes shall be designed to carry peak flows as determined by the methods previously described. Sizing conduit(s) or pipe(s) shall be determined by either Kutter's or Manning's formulae/equations or alignment charts using minimum standard pipe as specified within Section C.14 based upon a range of Manning Roughness Coefficients (N = 0.009 - 0.024).

4. Minimum Pipe Size
The minimum diameter for storm sewer pipe shall be 12 inches except smaller pipe (minimum 4 - inches) may be permitted for discharge from Stormwater Runoff Control Facilities in accord with Subsection E.

5. Minimum and Maximum Velocities
Velocities in storm sewer pipe, when flowing full, shall not be less than 2.0 feet per second for all pipes nor more than 20 feet per second for Bituminous Coated Galvanized Corrugated or Bituminous Coated Galvanized Spiral Rib Pipe. For velocities greater than 20 feet per second, for other pipe types, special provisions shall be made within the last pipe section before discharge (i.e., additional manhole, junction box, flatter pipe slope, etc.) to protect the sewer pipe outlet and drainage channel against erosion.

6. Gradients/Anchors on Pipe
Storm sewer pipe shall be laid on gradients so that the velocity (flowing full) shall be kept within the foregoing stated minimum and maximum, unless other special provisions are made. Sewers on 20 percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

a. Not over 36 feet center to center on grades 20 percent and up to 35 percent;

b. Not over 24 feet center to center on grades 35 percent and up to 50 percent; and

c. Not over 16 feet center to center on grades 50 percent and over.

7. Hydraulic Grade Line (HGL)

a. To ensure against on - street ponding or flooding, due to surcharging, the hydraulic grade line (HGL) or water surface elevation in any street inlet or manhole through which water would rise from a storm sewer may not be higher than the top of the inlet grade/grate.

b. Design of all storm sewer appurtenances shall consider the balance of energy plus the loss due to entrance in all structures having a critical change in horizontal or vertical alignment. Flow lines of pipes shall intersect (at centerline of manhole) except when a smaller pipe empties into larger pipe, having a difference of more than 6 inches in diameter. In the latter case, crowns of each pipe shall intersect horizontally, as extended. In no case shall storm sewer pipe sizes be reduced more than one standard increment of pipe diameter due to an increase in invert gradient after balancing the energy losses within the structure.

8. Manholes (Junction Boxes)

Manholes shall be constructed in accord with Standard Construction Drawings as shown in Appendix "C". Drop manholes may be used to reduce the slope of any sewer that has a discharge velocity that exceeds 20 feet per second. Whenever possible, connections shall be made at inverts of manholes to avoid use of drops.

9. Inlets

a. Capacity:

(1) Inlets at low points or sags should have extra capacity as a safeguard for street flooding from flows overtopping the street curb. Curb openings or combination inlets should be used for overflows in the event that the grate is clogged. Special inlets may be required for streets with steep gradients to provide the extra capacity such situations require. Where avoidable, inlets should not be placed along streets where driveways and/or aprons conflict with mountable roll or depressed curbing. The 10 - Year Design Storm return period shall be used to design stormwater inlets or other Design Storm required within Subsection B.2. Curb inlets and gutters shall approximate a storm intensity of four (4) inches per hour. Design methodology utilized should be similar to those presented in manuals produced by Neenah Foundry or the Kentucky Transportation Cabinet, where applicable.

(2) The capacity of the surface openings on off-street yard drains per Appendix C-21 shall not be less than two (2) times the discharge '(D' for a 10-Year Design Storm from the contributing drainage area to allow adequate discharge when debris accumulates. To improve safety at yard drains, ponding or headwater submerging such inlets shall not exceed a depth of 1.0

feet above the highest opening of any inlet at its surface for a 10 - Year Design Storm. A 25-Year Check Storm shall be used to further ensure against damaging flooding and property losses.

(3) The capacity of off-street inlets with enclosure grates or other open headwalls or culverts per Appendix 'C', where permitted, shall not be less than two (2) times the pipe diameter above the invert where water would rise to a maximum level for a 10-Year Design Storm for improved safety. A 25-Year Check Storm shall be used to further ensure against damaging flooding and property losses.

b. Type:

(1) On - street combination type inlets (single or double) shall be used and installed in accord with "Standard Construction Drawings" as shown in Appendix "C", or approved equal.

(2) Off - street type inlets shall be used and installed in accord with "Standard Construction Drawings" as shown in Appendix "C", or approved equal.

c. Location:

(1) Inlet spacing along streets shall be based upon gutter and inlet capacity, street slope, and contributing drainage area. The spacing of inlets should ensure that street drainage generated along continuous grades or in sags will not flood and damage private properties or residential basements. In general, the spacing of combination inlets shall not exceed the following requirements, unless detailed hydraulic computations indicate otherwise and are submitted with Improvement Drawings and Specifications:

(a) Along continuous grades (less than two percent) - 400 feet maximum;

(b) Along continuous grades (two percent and over) - 600 feet maximum;

(c) At sag locations (draining less than two percent grades) - 400 feet maximum between inlets or from a high point;

(d) At sag locations (draining two percent and over grades) - 600 feet maximum between inlets or from a high point;

(e) Inlets shall be placed when the gutter flow reaches 3.0 cfs including any by pass from inlets above.

(f) A safety swale, designed for the 100 year storm, shall be placed at the low points or sag of all streets. The maximum permitted depth of water at the centerline shall be 8 inches.

(g) When concentrated flow exceeding 3.0 cfs enters the gutter Line from adjacent property a yard box shall be placed at a point located a minimum of 75 feet off the edge of the street pavement. Yard box shall be designed to intercept sufficient water to limit the flow on to the street to a maximum of 3.0 cfs.

(2) Except for pre - existing undisturbed or rerouted drainage channels or other watercourses, inlet spacing within open channels or swales shall be regulated based upon the Manning formula for steady and uniform flow. Any combination of hydraulic factors estimated, computed or nomographed including discharge 'Q', open channel flat bottom width 'w' up to a maximum 6 feet, roughness coefficient 'n' and slope 'S' yielding a depth of flow 'd' of 1.0 feet or greater for the 10 - Year Design Storm shall require additional storm sewer and surface inlets per Section 7.0 C of these regulations to decrease flow depths to less than dangerous levels.

d. Special consideration should be given to storm drainage entering cul-de-sacs. Additional inlets shall be required when drainage areas and/or street slopes are excessive. In addition to an inlet provided near the low point within the cul-de-sac, two (2) additional inlets shall be required along each curb prior to the entrance of the cul-de-sac in accord with the following criteria:

(1) for street slopes less than eight (8) percent and draining more than 400 feet of pavement; and

(2) for all street slopes more than eight (8) percent and draining more than 300 feet of pavement.

10. Outfalls

When a storm sewer system outfalls into a floodplain of any major watercourse, the outfall must not be subject to frequent floods or backwaters. Standard headwalls and/or headwalls with wingwalls, including rock channel protection as aprons as erosion control, shall be constructed for all outfalls. Suitable baffles or other energy dissipaters shall be provided if maximum velocities are exceeded. The invert of the first storm sewer appurtenance upstream of the outfall structure shall be above the elevation of the flood plain.

11. Culverts and Bridges

Culverts and bridges shall be designed in accord with the methods given in the "Manual of Location and Design", published by the Kentucky Department of Highways; except that stormwater quantities to be handled by the culverts and bridges shall be determined on the basis described in these standards.

12. Headwalls, Safety Guards or Railings.

    a. Except for driveway entrance pipe, headwalls or other structures shall be constructed at the inlet and outlet of all storm sewers in accord with "Standard Construction Drawings" as shown in Appendix "C".

13. Other Drainage Improvement Measures

    Other drainage improvement measures may be undertaken to provide the necessary hydraulic characteristics required for adequate drainage. These other measures include stream bed clearing, removal of obstructions, stabilization of banks or areas to eliminate erosion, widening, deepening, or realignment of streams, construction of ponds behind dams, or other measures for adequate drainage.

14. Specifications for Construction and Materials

    In all other respects, the design, materials, and construction shall be as specified in Sections 601, 602, 610, 611, 612, 616, 706, 709, 710, 737, "State of Kentucky Standard Specifications for Road and Bridge Construction", and in accord with "Standard Construction Drawings", shown in Appendix "C". Non-circular pipe may also be specified.

    The following types of pipe shall be specified as a minimum for storm sewers, in accord with the following requirements:

    a. Reinforced Concrete Pipe (RCP AASHTO M 170, ASTM C76 and AASHTO Ml 98)
       (1) 27" - 120" Class II Wall A, B or C Max. Cover 11 feet;
       (2) 18" - 120" Class III Wall A, B or C Max. Cover 22 feet
       (3) 12" - 120" Class IV Wall A, B or C Max. Cover 36 feet.

       Notes: (1) Minimum Class III shall be required beneath all street pavements or driveways.
       (2) Design and installation shall be in accord with AASHTO Section 17 Soil-Reinforced Concrete Structure Interaction Systems, ASTM C12 or ACPA Design Data 40, where applicable, except that Pipe Bedding and Trench Conditions shall be per Appendix C.

    b. Bituminous Coated Galvanized Corrugated (2-2/3" x 1/2") Steel Pipe (AASHTO M36 Type 1, AASHTO M218 and AASHTO M190 Type A):
       (1) 12" - 36" 16 Gauge
       (2) 42" - 54” 14 Gauge
       (3) 60" 12 Gauge
       (4) 66" - 72" 10 Gauge

c. Bituminous Coated Galvanized Corrugated (3" x 1 ") Steel Pipe (AASHTO M36 Type 1, AASHTO M218, and AASHTO M190 Type A):
(1) 36" - 90" 16 Gauge
(2) 96" - 102" 14 Gauge
(3) 108" - 120" 12 Gauge

d. Bituminous Coated Galvanized Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M36 Type 1, AASHTO M218, and AASHTO M190 Type A):
(1) 18" - 36" 16 Gauge
(2) 42" - 54" 14 Gauge
(3) 60" - 72" 12 Gauge

Note: Bituminous Coating within items b. thru d. not required for driveway entrance pipe.

e. Aluminized Type 2 Corrugated (2-2/3" x 1/2") Pipe (AASHTO M36 Type 1, AASHTO M274)
(1) 12" - 36" 16 Gauge
(2) 42" - 54" 14 Gauge
(3) 60" 12 Gauge
(4) 66" - 72" 10 Gauge

f. Aluminized Type 2 Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M36 Type 1, AASHTO M274)
(1) 18" - 36" 16 Gauge
(2) 42" - 54" 14 Gauge
(3) 60" - 72" 12 Gauge

g. Aluminum Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M196 and Ml 97)
(1) 1 S" - 30" Gauge 14 Max. Cover 30 feet
(2) 36" - 48" Gauge 12 Max. Cover 30 feet
(3) 54" - 66" Gauge 1 0 Max. Cover 30 feet.

Notes: (1) All joints for corrugated and spiral rib pipe for items b. thru g. shall be special joints having bolt, bar and strap premium 'O' Ring Gasket connectors; (2) Design, installation and maximum height of cover (except as stated for item g.) shall be in accord with AASHTO Section 26 Metal Culverts except that Pipe Bedding and Trench Conditions shall be per Appendix C.

h. Polyvinyl Chloride (PVC) Pipe
(1) Smooth Wall:
(a) Pipe/Fittings: ASTM D 3034; ASTM F679; AASHTO M 278
Material: ASTM D 1784
Joint: ASTM D 3212

Sizes: 12" - 27" or other size available
Minimum Pipe Stiffness: 46 @ 5% deflection
Installation: ASTM D 2321.

(2) Ribbed:
(a) Pipe/Fittings: ASTM F794; ASTM F949; AASHTO M304
Material: ASTM D 1784
Joint: ASTM D3212
Sizes: 12" - 48" or other size available
Minimum Pipe Stiffness: 46 @ 5% deflection
Installation: ASTM D 2321

(b) Pipe/Fittings: AASHTO M 304
Material: ASTM D 1784
Joint: ASTM D 3212
Sizes: 18" - 48" or other size available
Minimum Pipe Stiffness: Variable @ 5% deflection
Installation: ASTM D 2321.

i. Polyethylene (HDPE) Pipe
(1) Corrugated:
(a) Pipe/Fittings: AASHTO M294 Type S
Material: ASTM D 3350
Joint: Minimum silt tight including: (a) thermally molded; (b) integral bell; or (c) bell and spigot with built-in gasket coupler assemblies only.
Sizes: 12" - 30" only
Minimum Pipe Stiffness: Variable @ 5% deflection
Installation: ASTM D 2321.

Notes: (1) Design, installation and maximum height of cover for items h. and i. shall be in accord with AASHTO Section 18 - "Soil - Thermoplastic Pipe Interaction Systems" except that Pipe Bedding and Trench Condition
shall be per Appendix C; (2) Design engineer shall be required to submit a special design or additional documentation for any variation to minimum standards as stated above. (3) Minimum height of cover for all pipe shall be 12-inches (measured from top of rigid pavement or bottom of flexible pavement) except for aluminum conduits with diameters greater than 48 inches require 24 inches; (4) All pipe installations greater than 42- inches require full-time on-site inspections under the direction of a qualified Geotechnical Engineer or Firm.

D. DESIGN FOR STORMWATER DRAINAGE CHANNELS, WATERCOURSES, AND EROSION CONTROL

Open channels provide many advantages in the management and control of stormwater runoff. Such channels provide for natural infiltration of stormwater into groundwater supply and extend the Time of Concentration (Tc), helping to

maintain the runoff rate nearer to that which existed prior to development. The objective of open channel flow design is: (a) to determine a channel slope and size that will have sufficient capacity to prevent undue flooding damage during the anticipated peak runoff period; and (b) to determine the degree of protection based on stream velocity to prevent erosion in the drainage channel. Existing drainage channels, which will remain undisturbed, shall not be required to be reconstructed unless additional capacity and erosion control is required.

1 . Determination of Quantity of Runoff

Each portion of the stormwater system. of drainage channels and watercourses shall be capable of handling the peak flows as determined by the RATIONAL METHOD procedure described previously in Subsection B.5-b. The SCS TR 55 Method described in Subsection B.5.a. may be utilized; but, only if full computerized data base modeling is used and submitted.

2. Drainage Channel Capacities

a. Drainage Channels shall be designed to carry peak flows as determined by the methods previously described. Channel cross-section areas shall be determined by Manning's Equation, using values as listed within Exhibit 7-7. Manning's Equation can only be used in areas where backwater conditions are not significant.

b. Open channels or swales within new land developments shall be designed to improve safety. Any combination of hydraulic factors estimated, computed or nomographed including discharge 'O', flat bottom channel width 'w' up to maximum 6 feet, roughness coefficient 'n' and slope 'S' yielding a depth of flow 'd' of 1.0 feet or greater for the 10-Year Design Storm shall require additional stormsewer and surface inlets per Section 7.0 C of these regulations to decrease flow depths to less than dangerous levels.

c. Roadside ditches and channels in local systems must have minimum four (4) foot shoulder from the edge of the pavement to the top of the bank.

d. Roadside ditches and channels in through systems must have a minimum eight (8) foot shoulder from the edge of the pavement to the top of the bank.

e. In areas where new sidewalks are proposed to cross wales, ditches, or channels, a culvert must be installed extending past the sidewalk sufficiently to allow a maximum 4:1 slope.

f. The 100-year discharge elevation must be checked to ensure that adjacent structures do not suffer flood damage, where applicable.

g. When open local and through drainage channels require various lining types to attain minimum design capacity, the earth sections of the drainage channel and its structure shall be designed to comply with the requirements within the Subsection D.3., which follow.

h. Lining will not be required in the initial construction and may be delayed until development of the area produces runoff quantities large enough to result in erosive channel flows, unless drainage channel velocities are excessive initially.

3. Erosion Control for Local and Through Channels

Runoff flows in open channels may cause accelerated erosion. Such erosion can be controlled by limiting velocities, changing the channel lining, and reshaping the channel to spread the flow of runoff. Methods of controlling erosion in open channels include the following: (1) grass covers or sod; (2) stone rip-rap, coarse aggregate, and/or dumped rock channel lining; and (3) reinforced concrete or precast paving. Erosion control for drainage channels shall be provided as follows:

a. Velocities of less than one and one-half (1.5) feet per second (fps). Design velocities should generally be greater than 1.5 fps to avoid excessive deposition of sediments. When flat slopes are unavoidable, concrete paving may be used to accelerate runoff.

b. Velocities between one and one-half (1.5) and four (4) feet per second. The bottom and sides of the earth channel shall be seeded, mulched, and fertilized to an elevation of three (3) feet above the design water surface. Seeding shall be a perennial or annual mixture of grass seeds at a rate of 100 pounds per acre. Acceptable fertilizer shall be applied at a rate of 75 pounds per one thousand feet. On slopes over five (5) percent, the bottom and sides of the earth channel

may be sodded and pegged to remain in place. Where seeding or sodding is used, and the soil is not capable of supporting vegetation (such as, sandy soil or other clay types) appropriate action shall be taken to bring the soil to an acceptable condition which will support the growth of seed or sod.

c. Velocities over four (4) feet per second. The bottom and sides of the earth channel shall be protected from erosion with an application of stone rip-rap, coarse aggregate, and/or dumped rock channel linings. The type of application thickness and quantities shall be designed by the engineer to ensure low maintenance permanent stabilization. Reinforced concrete pavement, at least four inches thick, may also be used at bends, changes in alignment, junctions with other ditches, and at other locations where erosion is likely to occur. On slopes over ten (10) percent, consideration should be given to the construction of larger sized channel linings, gabions

(wire boxes), or paved channels with energy blocks or dissipaters to reduce excessive velocities and damage to receiving streams.

d. Consideration shall be given for the construction of other methods of linings for erosion control, including check dams, drops structures, gabions, etc., subject to approval of the planning commission's duly authorized representative.

4. Drainage Channel or Watercourse Relocations

In order to minimize hillside slippage near relocated drainage channels or watercourses, due to drainage channel depth or character of the earth in the drainage channel fill and side slopes, precautions shall be taken to compact the fill and side slopes, provision of underdrainage, bank protection or reinforcing or other measures. Additional easement width shall be provided at such possible slide areas.

5. Erosion Control

All graded areas are to be maintained at all times to prevent erosion and excessive runoff. Several methods used to prevent soil erosion during development are included in Appendix "C". Drainage swales, silt checks, temporary retention dams, etc., are to be used during the grading operation. All slopes and graded areas are to be seeded as soon as practical after the grading operation has been completed and/or building development has been finished. However, all graded slopes greater than 4H:lV must be seeded and mulched immediately following completion of final grading

operations to minimize rutting and more significant repair operations later. Additional erosion control measures, to prevent erosion and excessive runoff, may be required if the developer or builder has not accomplished same. Best Management Practice Plan (BMP) shall be submitted to the planning commission.

6. Mud and Debris

Until infrastructure improvements in the subdivision have been completed, the subdivider shall take such measures as are necessary to prevent erosion of graded surfaces, and to prevent the deposit of soil and debris from graded surfaces onto public streets, into drainage channels or sewers, or onto adjoining land.

7. Specifications for Construction and Materials

In all other respects, the design, materials, and construction shall be as specified in Sections 204, 210, 212, 601, 703, 709, 710, State of Kentucky Standard Specifications for Road and Bridge Construction and in accord with "Standard Construction Drawings" shown in Appendix "C".

8. Lot Grading and Drainage

a. Lot grading shall be accomplished as follows: Except for driveways in transition (higher or lower than the street - See Appendix "C") within the limits of the public right-of-way adjacent to street pavements, all final grading for grass strip, driveway and sidewalk, shall comply with minimum and maximum grades in accord with typical sections for streets as shown in Appendix "C". For lots that drain toward streets which include curb and gutter sections, the area in the right-of-way within four (4) feet back of the curb shall be graded so that water drains to the street at a minimum grade of 1 inch per foot (approximately 8 percent). In the area reserved for sidewalks and/or driveways (i.e., four (4) to eight (8) feet back of the curb in single or two-family areas or four (4) t o nine (9) feet in multi-family or commercial areas), a minimum final grade of 1/4 inch per foot (approximately 2 percent) toward the street is required. For streets with or without curb and gutter or sidewalks which include side ditches, refer to typical section within Appendix "C". All grading behind the street shall be done in a fashion that does not allow ponding of water adjacent to the paved street. For lots that drain away from the street, the area in the right-of-way within four (4) feet back of the curb shall be graded so that water drains away from the street at a minimum grade of 1/2 inch per foot (approximately 4 percent).

b. Lot areas outside of the limits of the building structure shall be graded toward or away from a point four (4) feet back of the curb so that water drains away from the building at a minimum grade of 1/4

inch per foot (approximately 2 percent) toward the street or into swales or natural drainage areas.

(1.) Top Soil: If grading results in the stripping of top soil, top soil shall be uniformly spread over the lots as grading is finished.

(2.) Trees: As many trees as can be reasonably utilized in the final development plan shall be retained, and the grading adjusted to the existing grade of the trees where practicable.

C. Swales carry surface runoff from roofs, yards, and other areas to the rear of lots or along common property lines to streets or other drainage areas to prevent ponding of water near building structures or other portions of the lot. Surface drainage swales shall have a minimum grade of two (2) percent and shall be constructed so that the surface water will drain onto a street, storm inlet, or natural drainage area. Swales for handling lot drainage shall be constructed as a part of final lot grading and be seeded and mulched or sodded as soon as possible to prevent erosion.

d. Roof downspouts, footing, or foundation drains shall be discharged onto the same parcel of land from which the water is generated. Roof downspouts shall be piped to natural drainage areas away from the street or onto concrete splash blocks, which direct water away from the building structure into swales or other natural drainage areas. Except as permitted by adopted policy within residential property regimes, downspouts or other subsurface drains constructed toward the street shall be discharged on the surface as far back onto the lot as possible and in no case be closer than 20 feet back from the nearest curb of the street. Roof and subsurface drains shall not be connected thru the curb or into the gutter section of the street. Any connection into a storm sewer or catch basin must be approved by the inspector.

E. DESIGN OF STORMWATER RUNOFF CONTROL FACILITIES

Detention/retention storage facilities for developments shall be designed to store accelerated stormwater runoff for a recurrence interval and duration required while allowing discharges for through and local pre-development rates of runoff to pass through uncontrolled.

Except as allowed under Waivers as considered within Subsection E.2., detention/retention storage facilities are required for all land uses within the county including single and multi-family residential, mobile home park,

urban and rural commercial, shopping center, professional office, planned unit development, mixed land use, research park, institutional, industrial, and public facilities. Such facilities are also required for other impervious hard surfaces generating increased runoff requiring storage in accord with these regulations.

1. Detention Basins

This section includes additional technical criteria necessary to design stormwater detention basins. Detention basins are typically designed to remain virtually empty during dry weather and backup or detain excessive runoff generated during a storm.

a. Design Flow - For project sites where the pre - development peak discharge has been calculated by the Rational Method, a discharge hydrograph must be calculated for the site using one of the SCS methods or another method that receives approval from the planning commission's engineer (See subsection B.4.c). For project sites where a land development's local drainage area contributes direct runoff, the SCS TR55 or the Modified Rational Method(MRM) procedures may also be used to estimate volume of a Detention Basin. Unlike the Modified Rational Method (MRM), the SCS TR55 Method for Northern Kentucky uses the Type 11 rainfall Distribution based upon the 24 hour steady storm duration nothing more nothing less.

b. Basin Design

(1) A minimum basin volume shall be the difference between the post - development and pre - development 50 - Year storm discharge (rates) discharged from the project area to the basin site, or such volume necessary to sufficiently reduce post-development discharges to the pre-development rate as controlled by the discharge structure. If the basin is to be located directly on a portion of the through drainage system, volume calculations must also consider the total system flow reaching the basin. The water surface at the crest of the emergency spillway shall not exceed five (5) acres. The designer must contact the planning commission's duly authorized representative for direction in these cases.

(2) Maximum side slopes shall be 3:1, unless paved or rip rapped.

(3) Minimum low flow channel slopes shall be grass if the channel slope is 1.0% or greater or paved if less than 1.0%. Low flow channels shall not have less than 0.5% slope.

(4) Basin design must include maintenance accessibility and responsibility.

(5) Requirements of the Dam Safety Law shall be observed. Failure of the structure will not result in loss of life, damage to homes, or interruption of use or service of public utilities.

(6) The designer shall address provisions for anti-seep collars, extended detention basins, wet ponds, soft engineering, baffles, outlet protection and length to width ratios shall be addressed.

C. Basin Discharge

(1) Discharge control structures shall be multi-stage and capable of limiting 2 and 50-year post-development discharges to pre-development peak discharge rates and shall be constructed of concrete or other hardened materials including pipe or approved alternate or equal.

(2) The emergency spillway shall be sized to accommodate a flow equal to the 100-year storm post-development discharge.

(3) The dam crest elevation shall not be less than one (1) foot above the emergency spillway invert or overflow elevation.

(4) For basins installed on a regulated blue-line stream drainage system as shown on USGS maps, water surface profile for maximum storage shall be in accordance with FEMA guidelines for the appropriate watershed.

(5) Discharge velocities within pipe must be controlled to same requirements within Subsection C.5. Erosion control linings for open channels must comply with Subsection D.3..

(6) Storage, discharge, and routing calculations for the 2-year, 50-Year, and 100-year discharges must be submitted for review.

(7) Spillways shall be protected from erosion and shall employ energy dissipation, if necessary.

(8) Detention basins shall be fully discharged within 36 hours of the storm event.

d. Basin Construction Sequence

(1) The detention basin shall be the first item of construction as a part of earthwork grading prior to other infrastructure.

(2) Design of the basin must be checked for capacity due to additional runoff generated by disturbed site conditions.

e. Parking Lot Storage

(1) Parking lot storage involves shallow ponding in a specifically graded area of a parking lot.

(2) General design requirements include:

(a) Maximum water depth - 8 inches.
(b) Minimum ponding area distance from buildings - 10 feet.
(c) Maximum surface slope - 5.0%
(d) Minimum surface slope - 1.0%

2. Waivers for Stormwater Runoff Control Facilities

Certain factors, variations, and/or options will be considered in granting waivers for on-site storage design as part of the review process at the site plan, Preliminary Plat, Improvement Drawings and Specifications and/or Waivers granted will be determined from the following:

a. All agricultural uses unless otherwise required by other federal and/or state agencies regarding stormwater regulations as "permitted".

b. All residential rural estate and single-family residential developments having a minimum lot size of at least one (1) acre or greater provided that the increase in runoff calculated using runoff curve numbers (RCN) or runoff coefficients (C) does not cause problems, deficiencies and damages in the length of channels or reaches downstream determined by a hydrograph based upon the time of concentration or duration of the design storm required. In any development where a storage design is required credits are prohibited. Post - Development runoff curve numbers (RCN) or runoff coefficients (C) may not be less than pre - development runoff curve numbers (RCN) or coefficients (C).

c. Where increased runoff from a development flows into a preexisting downstream storage facility and routing channels and storage capacity through such facilities are analyzed and improvements made, where necessary or required.

d. Where detention/retention storage design is not appropriate to result of hydrograph analyses, and peak discharge and runoff volumes do not pose a problem or result in damages within the length of open channel or closed conduit determined by the time of concentration or duration of the design storm required.

e. Buildings and their related parking areas and other structures where less than two (2) acres of land is to be altered by grading, draining, removing existing ground cover or paving; and, of which 1/2 acre or less will be impervious acres such as roofs, walks, and parking areas. However, this waiver is based upon the stipulation that such impervious hard surfaces are an isolated part of drainage area and not a part of the same drainage or watershed area contributing to an accumulated and combined discharge exceeding the downstream discharge/runoff control requirements of these regulations.

f. Where increased runoff from a development is stored in upstream or downstream storage facility and routing channels and storage capability of such facility is analyzed and provided.

SECTION 7.1 SANITARY SEWER SYSTEM: Except as herein provided, the subdivider shall construct a sanitary sewage collection system designed to serve adequately all lots in his subdivision plus lines adequate in size to facilitate the orderly development of nearby land which is an integral part of the neighborhood service or drainage area (see Section 7.11 of these regulations) and connect said collection system to a centralized sewerage system, or an approved package treatment plant (surface discharge), except as herein provided.

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered professional engineer, showing the proposed sanitary sewerage system and facilities. Said plans shall show pipe sizes, gradients, type of pipe, invert elevations, location and type of manholes, the location, type and size of all lift or pumping stations, location, type and capacity of all proposed package treatment plants, and all construction details including such information as required by the planning commission's engineer.

B. DESIGN STANDARDS: Where applicable, the design criteria for the sanitary sewerage system shall comply with the following published standards, regulations or laws, as applicable:

a. "Recommended Standards for Sewage Works" prepared by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, Health Education Service, Inc., Albany, New York, 1978;

b. Rules and Regulations of county and/or cities.

c. State Water Laws and Regulations, and other state statutes, as applicable.

C. MATERIAL AND CONSTRUCTION SPECIFICATIONS: Material and construction specifications, including testing requirements for all sanitary

sewer projects shall be in accordance with Rules and Regulations of county and/or cities, except as herein provided.

Except as herein provided, individual on-site disposal systems may be permitted in those areas, which will not require urban type services, provided that said sites contain a minimum area of one (1) acre, with a minimum lot width at the setback line of 100 feet.

(1) The subdivision shall consist of no more than ten (10) lots; and

(2) Said system shall be provided with an aerobic type treatment plant, with a subsurface discharge, approved by the Kentucky District Health Department.

Where new street rights-of-way are created, or new streets constructed within an existing right-of-way, all existing lots or newly subdivided lots shall be required to connect to a centralized sewerage system, as provided for in this section. In the event that existing sanitary sewer lines are located within a reasonable distance of the site, as determined by the planning commission, then said site shall be connected to the public sanitary sewer system. Where permitted under these regulations, all such systems shall also be approved by the District Health Department.

SECTION 7.2 WATER SYSTEM: It shall be the responsibility of the subdivider to contact the Water District (Williamstown, Bullock Pen, etc.), indicating his proposed layout of the water distribution system, according to the subdivision procedures identified in Article III of these regulations. The waterline shall serve adequately all lots within the proposed subdivision plus coordinated with the Water District (Williamstown, Bullock Pen, etc.), to provide water lines adequate in size to facilitate the orderly development of nearby land which is an integral part of the neighborhood service area (see Section 7.11 of these regulations).

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered professional engineer, showing the proposed water system. Said plans shall show line sizes, type of pipe, location of hydrants (minimum 500 feet spacing) and valves and other appurtenances.

B. DESIGN STANDARDS: The design criteria for the water distribution system shall be as required by the Water District (Williamstown, Bullock Pen, etc.). The applicable agencies should make provision to insure necessary fire flow requirements.

C. ON-SITE DISPOSAL SYSTEM/WATER SYSTEM: In those areas where on-site disposal systems are permitted as provided for in Section 7.1, D., a., connection to the applicable water agency's supply shall not be required.

SECTION 7.3 STREETS:

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered engineer showing the proposed

street system.

Said plans shall show the proposed right-of-way width, pavement width, location and the proposed alignment, grade, geometric details and typical cross-sections of each pro-posed street, including curbs and gutters and sidewalks (where applicable). Said plans and specifications shall show for each proposed street, design criteria such as street classification, pavement classification and thickness and classification and thickness of base and subbase materials.

In addition, the following information shall be required:

1 . The plans and profiles of all surrounding streets which are to connect to a street in the proposed subdivision (for a distance of one hundred(100)feet back from the boundary line of the proposed subdivision).

2. All profiles shall be drawn at a scale not to exceed one inch = 50 feet (horizontal) and one inch = 10 feet (vertical).

3. Existing and proposed grade elevations shall be shown at all regular station points including vertical sag P.I.(s), P.C.(s) and P.T.(s) and percent grade between P.I.

4. Elevations shall be tied to a bench mark (U.S.G.S. or other benchmarks when available), when, within a reasonable distance (as determined by the planning commission's engineer) and shall be shown on the Improvement Drawings and Specifications.

5. Details of curb and gutter, sidewalks, street section and paving shall be shown.

B. PAVEMENT SPECIFICATIONS: All streets shall be paved with Portland Cement concrete or asphalt concrete and constructed in accordance with the specifications in Appendix "A" or "B" (whichever is applicable) of these regulations.

C. MINIMUM PAVEMENT WIDTHS: Pavement widths shall be measured from back of curb to back of curb, or if no curbs are required, then measurements shall include the entire paved surface. Minimum pavement widths for each street shall be as shown in Table 3 and laid out in the manner indicated by the typical street cross sections shown in Appendix "C".:

D. CURBS AND GUTTERS: The subdivider shall construct vertical curbs, at least six (6) inches in height or roll curbs four (4) inches in height, for all residential streets (where applicable) as identified in Table 3. For streets to be constructed of asphalt concrete, curb and gutter shall be constructed according to the typical section detail in Appendix "C".

All curbs and gutters shall be constructed of Portland Cement concrete and in accordance with the specifications in Appendix "A" and typical cross-sections in Appendix "C".

E. CURB RADII: The minimum curb radius at intersections shall be as follows:

TYPE OF STREET* INTERSECTION	MINIMUM CURB RADIUS (IN FEET)
Local - Local or Subcollector	25
Subcollector - Subcollector	25
Subcollector - Collector	30
Collector - Collector	30
Arterial - Arterial	

* In the case of local or collector streets located in commercial or industrial areas, the minimum curb radii shall be increased to fifty (50) feet.

** Shall be based on current design standards of the Kentucky Department of Transportation.

F. SIDEWALKS: Sidewalks shall be required as identified in Table 3 of these regulations. Sidewalks shall be constructed of Portland Cement concrete in accordance with the specifications of Appendix "A" of these regulations, at least four (4) inches thick and increased to five (5) inches of thickness when included as part of a driveway. All sidewalks shall be constructed with a minimum width of four (4) feet and this width increased to five (5) feet for streets in multi-family residential and commercial, where pedestrian traffic volume indicates the need for this additional width. (Sidewalks shall be laid out in the manner indicated by the typical cross-sections shown in Appendix "C".) (Sidewalks shall meet all criteria of the American Disability Act.)

G. PARKING: Parking on any street where pavement width is less than thirty-six (36) feet shall be limited to one side of the street, except as otherwise noted within Table 3. Parking lanes shall not be shifted from one side to the other from block to block or where the proposed street is the extension of an existing street the parking lane shall extend continuously on the same side of the street. If practicable, the parking lane shall be located on the opposite side of the street from where the fire hydrants are located.

H. CUL-DE-SAC AND DEAD-END STREET: Cul-de-sac courts and dead-end streets shall be designed in accordance with the typical design details as per Appendix "C" of these regulations. However, if conditions warrant, other turnaround designs may be permitted by the planning commission or its engineer. If such street is of a temporary nature and a further extension into adjacent land is anticipated, then said turnaround, beyond normal street width, shall be in the nature of an easement of the premises included in said turnaround, as per the typical design in Appendix "C". Such easement may be vacated to abutting property owners when said deadend street is legally extended into adjacent land. If such deadend street serves four (4) lots or less, no temporary turnaround will be required.

I. CONSTRUCTION OF REQUIRED PAVEMENT WIDTH ON EXISTING STREETS: When a subdivision is located on only one side of an existing street, and where the pavement width of such existing street is less than that required by these regulations, the subdivider shall be required to construct one-half (1/2) the required pavement width, as per these regulations, along the side fronting his property on such street. If the required widening is less than two (2) feet then it shall not be required, except when the required widening on the subdivider's side is less than two (2) feet.

When pavement widen is required under the section, The requited pavement width shall be 22 feet when no lots front on the street requiring widening. When lots front on the street requiring widening the pavement with shall be as in Table 3.

J. INTERCONNECTION/EXTENSION

1 The arrangements of streets in new subdivisions with an existing street or streets or adjacent undeveloped land shall make provision for projection of streets to those adjoining areas in a timely fashion as required with approval of a Preliminary Plat, per Section 3.3 of these regulations.

2. Improvement Drawings and Specifications for interconnection with an existing street or extension to adjoining land shall be submitted for approval and construction when either one of the following conditions
exist:

a. At least twenty-five percent (25%) of the lots or units approved as a Preliminary Plat or ten (1 0) lots or units, whichever is less, remain unplatted without construction of improvements and a secondary interconnection or extension to adjoining land; or

b. The terminus or stub of a street constructed in a new subdivision is 300 feet or less from such interconnection or projected terminus at the adjoining land.

Determination of compliance shall be made by the planning commission's engineer prior to approval of any new phase of Improvement Drawings and Specifications or individual Section of a Final Plat within the subdivision. Zoning and/or building permits shall not be issued within the subdivision by the applicable legislative body until determination of compliance is made by the planning commission's engineer.

3. Improvement Drawings and Specifications for construction as required per Section 7.3, J., 2, shall include plans for grading,

storm and sanitary sewers and water system per Section 3.5 of these regulations.

4. Final Plat for interconnection or extension shall include street right-of-way dedication to public use abutting existing street right-of-way or adjacent undeveloped land. Remnants of land, devil or spite strips are prohibited by Section 6.6, D, 2 of these regulations.

5. Guarantee may be filed with the planning commission's engineer in lieu of actual installation or completion of the required public improvements per Section 7.16 of these regulations.

SECTION 7.4 DRIVEWAY APPROACHES: Driveways for residential areas (single and two-family) shall be provided with a minimum width of nine (9) feet increasing in width by four (4) feet at the curb (i.e., two (2) foot flare or taper on each side of driveway) for court, cul-de-sac, local, subcollector and collector streets. In areas of heavier traffic volumes or where special conditions are encountered (Multi-Family, Industrial, Commercial areas), increased driveway widths, plus increased minimum radii or flares may be required by the planning commission, or its engineer. Except for driveways in transition from upward to downward slopes, all driveways within the right-of-way shall be constructed in accordance with standard construction details within Appendix "C" and 'the specifications of Appendix "A" or "B" (whichever is applicable) of these regulations. Within the street right-of-way area, grades for upward sloping driveways within four (4) feet of the curb shall not be less than 1 inch per foot (approximately 8 percent) nor more than 2 inches per foot (approximately 16 percent). Grades for downward sloping driveways within four (4)-feet of the curb shall not be less than 1/2 inch per foot (approximately 4 percent) nor more than 2 inches per foot. Sidewalks included as part of driveways or separate therefrom shall not be less than 1/4 inch per foot (approximately 2 percent) nor more than 1/2 inch per foot. Grades for upward or downward sloping driveways between edge of sidewalk and right-of-way line shall not be less than 1/4 inch per foot nor more than 2 inches per foot.

SECTION 7.5 OFF-STREET PARKING AREAS: Off-street parking areas shall be constructed in accordance with the requirements of the applicable zoning ordinance, unless additional off-street parking is required as per these regulations.

SECTION 7.6 TELEPHONE AND ELECTRICAL UTILITY LINES: Unless required by the zoning ordinance, all new telephone and electrical utility lines should be installed underground and be in conformance with the appropriate utility company's policy and requirements.

SECTION 7.7 STREET SIGNS:

A. STREET NAME SIGNS: The applicable legislative body or fiscal court should arrange for installation of street signs at all street intersections. The signs shall conform to the specifications of the applicable legislative body or fiscal court and be mounted at a height of approximately seven (7) feet above the top of the curb or the crown of the pavement. They shall be located on diagonally opposite corners on the far right hand side of the intersection for traffic on the more important streets.

B. TRAFFIC CONTROL SIGNS AND DEVICES: The applicable legislative body or fiscal court shall arrange for the installation of traffic control signs and devices which shall be in conformance with the "Manual on Uniform Traffic Control Devices" as prepared by the Joint Committee on Traffic Control Devices, U.S. Department of Commerce, Bureau of Public Roads, as amended.

SECTION 7.8 STREET LIGHTS: The applicable legislative body or fiscal court, when required, shall arrange for the developer to install street lights in the subdivision.

SECTION 7.9 PLANTING SCREEN OR FENCES: The Planning Commission, or its engineer, may require and permit planting screens, fences, or masonry walls, as required by the applicable zoning ordinance.

SECTION 7.10

A. MONUMENTATION:

1. All corners of the boundary survey shall be monumented or witness monumented. Every monument set shall be of a type or character having a degree of permanency consistent with that of the local terrain and physical features. Wherever possible, monuments shall be made of a permanent material that makes it possible for the monument to be detected by a device capable of finding ferrous or magnetic objects. Types of acceptable monuments include, but are not limited to, iron pipes, iron pins, iron rods, re-bars, chiseled crosses, railroad spikes, mine spikes, P.K. nails and drill holes. Wooden stakes shall not be use as monuments. Each iron pipe, iron rod, iron pin or re-bar monument set by a land surveyor shall bear his registration number on a manufactured cap or identifier.

2. Existing permanent manmade or natural features are acceptable monuments. Where manmade or natural features are subject to change, realignment or misinterpretation, such monuments or features shall be "witness monumented."

3. "Witness monumentation" shall be used when it is not possible or practicable to set the actual corner. Whenever witness monumentation is used, it shall be placed "on line" if possible and shall be shown on plats and called for in descriptions..

B. OTHER MONUMENTS: Other monuments set shall be metal pins of no less than one-half (1/2) inch diameter and no less than twenty-four (24) inches in length. Monuments of this type shall be set at all of the following locations:

1. At every point of intersection of the outer boundary of the subdivision with an existing or created right-of-way line of any street, railroad, or other way.

Appropriately identified markings shall also be located at each point along the street curb which intersects with the side lot lines of each lot.

SECTION 7.11 PLANS FOR FUTURE

EXPANSION - EXTRA SIZE AND OFF-SITE IMPROVEMENTS: All improvements shall be installed to satisfy the service requirements for the service or drainage area in which the subdivision is located and the improvements shall be of sufficient capacity to handle the expected development of the overall service or drainage area involved.

A. EXTRA-SIZE IMPROVEMENTS: Where the planning commission's engineer has determined that improvements in excess of the size needed to serve just the proposed subdivision are required, the subdivider shall be so notified and arrangements for construction shall be agreed upon.

SECTION 7.12 PLANS REQUIRED FOR GRADING AND CONTROL OF EROSION AND SEDIMENTATION: Any developer who intends to make changes in the contour of any land proposed to be subdivided, developed, or changed in use by grading, excavating, or removing the natural topsoil, trees, or other vegetative covering thereon, shall submit a plan for grading and erosion and sedimentation -control to the planning commission's engineer for approval..

Such plans, if required, shall contain adequate grading measures including the control of erosion and siltation where necessary, using current acceptable guidelines and requirements contained herein.

A. REQUIREMENTS:

1. One (1) set of plans for grading and the control of erosion and sedimentation shall be submitted to the planning commission's engineer, as per the procedures established in Article Ill.

2. In the event the planning commission's engineer recommends final plat approval before construction of improvements, as per Section 3.9, A., 2., measures to be taken to control erosion and sedimentation shall be included, in the plans above as provided as per these regulations.

3. During the construction phase, further technical assistance may be furnished, if requested, by the planning commission's engineer, or by the local representative of the Natural Resources Conservation Service. However, the planning commission, or its engineer, shall enforce compliance with the approve plans.

4. The planning commission's engineer shall make periodic inspections of the methods used and the overall effectiveness of the erosion and sedimentation control program.

B. EARTHWORK GRADING AND EROSION CONTROL MEASURES: The following control measures should be used for an effective erosion and sedimentation control plan for the area under development:

1. The smallest practical area of land should be exposed at any one time during development.

2. When land is exposed during development, the exposure should be kept to the shortest practical period of time.

3. Where necessary, after grading, temporary vegetation and/or mulching should be used to protect areas exposed during development.

4. Sediment basins (debris basins, de-silting basins, or silt traps) should be installed and maintained until ground cover has been completed to remove sediment from runoff waters from land undergoing development.

5. On-site provisions should be made to effectively accommodate the increased runoff caused by changed soil and surface conditions during and after development.

6. The permanent final vegetation and structures should be installed as soon as practical in the development.

7. The development plan should be fitted to the topography and soils so as to create the least erosion potential.

8. Wherever feasible, natural vegetation should be retained and protected.

SECTION 7.13 CONSTRUCTION INSPECTIONS:

A. AUTHORITY AND DUTIES OF INSPECTORS: Inspectors, except for inspectors employed by other public agencies including a state highway or plumbing department, county-wide water district, and/or sanitation district or private developers or contractors responsible for specialized inspections under the direction of a qualified Geotechnical Engineer or Firm, are authorized to inspect all work done and all materials furnished. Each inspector shall have one (1) complete set of all plans and specifications with certified approval by the planning commission's engineer. Such inspection, including final inspection, may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector shall not be authorized to revoke, alter, or waive any requirements of the approved grading plans related to public improvements construction, erosion control plans, and Improvement Drawings and Specifications, but authorized to call to the attention of the contractor, any failure of the work or materials to conform to the approved grading plans related to public improvements construction, erosion control plans, and Improvement Drawings and Specifications. Contractors shall notify the inspectors at least 12 hours prior to the time when the work is to begin on each phase of construction, including erosion control, earthwork related to public improvements, storm sewer systems, sanitary sewer

systems, street paving and driveway/sidewalks including all related testing, etc., where applicable.

The inspector shall commence inspections at the time of work starts and continue inspections necessary and appropriate in the circumstance as the work progresses on each phase of the project until all construction is complete. Further, and during construction, any work determined by the inspector not to conform to the requirements of the approved Grading Plans including erosion control, and Improvement Drawings and Specifications or other requirements of these regulations shall be suspended and such construction brought into conformance with plans and standards as approved. When significant deviations of the design as approved are observed, the design engineer shall be notified, and proper and adequate direction given, prior to proceeding with that phase of the project. Any question at issue which cannot be determined to conform with the approved Grading Plans including, Erosion Control Plans, and Improvement Drawings and Specifications, shall be referred to the planning commission's engineer, who shall inform the contractor, within 24 hours of such referral, what actions are necessary in order to proceed. The planning commission acting through its engineer, reserves the right to order items removed and replaced and additional testing when work was per-formed contrary to approved plans and specifications, or without adequate notification for inspection. Following final inspections of improvements, the planning commission's engineer shall certify, in writing, to the applicable cities and/or fiscal court, that improvements have been constructed and/or completed in accord with grading plans including, erosion control plans, and Improvement Drawings and Specifications and inspected per these regulations, if such is the case.

SECTION 7.14 CONSTRUCTION RESPONSIBILITIES:

A. COOPERATION OF SUBDIVIDER AND/OR CONTRACTOR: The subdivider and/or contractor(s) shall have available on the project, one (1) complete set of all plans and specifications, as approved by the planning commission's engineer and other local and state government agencies, where "permitted". Contractors shall cooperate with the inspector and with other contractors in every way possible. The subdivider and/or contractor shall, at all times, during actual construction, have a competent superintendent acting as his agent on the project. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and he shall receive instructions from the inspector. The superintendent shall have full authority to execute the orders or directions of the inspector. A superintendent shall be furnished irrespective of the amount of work sublet. Subdividers and contractors are not relieved of other responsibilities and requirements of other state and local agencies relating to zoning, permits, etc., which may be beyond the scope of requirements of the Subdivision Regulations. Satisfactory completion of inspections and certification that improvements have been constructed in accord with grading plans, erosion control plans, and improvement drawings and specifications per these regulations, shall not

be a defense in an action for damages against anyone who may be liable by
reason of non-compliance with the requirements of these regulations.

SECTION 7.15 FINAL CLEANING UP: Upon completion of the work, the subdivider and/or contractor shall clean up all ground occupied or affected by him in connection with the work.

SECTION 7.16 AGREEMENTS AND GUARANTEES:

A. GUARANTEES: The subdivider may execute and file guarantees with the applicable city legislative body or fiscal court and the planning commission's representative, in lieu of actual installation or completion of the required improvements, except sidewalks, when requesting approval of the final plat. In the case where sidewalk improvements have not been completed (i.e., construction of sidewalks as regulated herein are the responsibility of the builder and owner of the lot in question and are not required to be completed or guaranteed prior to final plat approval), a conditional certificate of occupancy may be given by contract with the applicable legislative body or fiscal court not to exceed six (6) months signed by both the builder and owner of the premises for which the improvements will serve.

Guarantees, except for sidewalks, shall be based on a cost estimate for the required improvements, for each phase of uncompleted construction as estimated by the subdivider's engineer. Such guarantees shall run to the applicable city legislative body or fiscal court. Copies of such guarantees shall be submitted to the planning commission and approved by the planning commission. The cost estimate shall be based on the amount determined to be reasonably necessary to complete all of the improvements required to be constructed by the subdivider, as specified in the approved improvement drawings and specifications, including a fifteen (15) percent contingency plus engineering fees and the fees for plan review and construction review as established by the By-Laws.

Except as herein provided, the guarantee shall be in the form of a good and sufficient surety bond, executed by the subdivider as principal, and a corporation authorized to act as a surety under the laws of the state of Kentucky, as surety. The guarantee shall be an assurance of faithful performance of any and all work and the construction and installation of all improvements required to be done by the subdivider, as specified in the approved improvement drawings and specifications, together with contingency plus all engineering fees and the fees for plan review and construction review as established by the By-Laws.

Except as required within Section 7.3, J. regarding street interconnection/ extension, the guarantee shall contain the further condition that, should the subdivider fail to complete all work and improvements required to be done by him within twenty-four (24) calendar months of the date of approval of the final plat, or within a mutually agreed upon extension, but never to exceed twelve (12) consecutive 7-40
calendar months, that the

applicable city legislative body or fiscal court shall cause all required work to be done and

improvements constructed. The parties executing the guarantee shall be firmly bound for the payment of all necessary costs therefore. Whenever the subdivider elects to execute alternative forms of guarantee (i.e., cash, bonds, letter of credit, escrow agreement, etc.), written authorization from the chief or other designated administrative officer of the applicable legislative body or fiscal court concerning its adequacy, amount, etc. shall be filed with the planning commission prior to approval of such guarantee and a final plat. All guarantees shall include a provision that, in the event of any default on the part of the subdivider or the performance of any work or construction of any improvements for which such guarantees have been deposited, to cause the required work to be done and to withdraw that amount required for payment of all costs therefore.

Following final inspections of improvements, the planning commission's engineer shall so certify in writing to the applicable city legislative body or fiscal court to permit the release or return of the guarantee to the subdivider or surety within ten (10) days of such final inspection certification. descriptions

TABLE 3
IMPROVEMENT REQUIREMENT BY TYPE OF SHEET
SERVING SUBDIVISIONS

TYPE OF STREET (F)	NUMBER OF LOTS SERVED	RIGHT-OF-WAY (IN FT.)	PAVEMENT WIDTH (IN FT.)	CURB AND GUTTER (C)	SIDEWALKS ALONG STREET	ON-STREET PARKING	MINIMUM FRONT YARD DEPTH REQUIRED (IN FT.)
COURTS - Deadend	Under 7	50	25	YES	Both Sides	One Side	(A)
Typical							
Optional							
CUL-DE-SAC - Deadend	7-25	50	25	YES	Both Sides	One Side	(A)
Typical		50	22	NO		None	75
Optional							
LOCAL		50	25	YES	Both Sides	One Side	(A)
Typical	Under 100	50	22	NO	Both Sides (B)	None	75
Optional							
SUB-COLLECTOR	100-500	50	28	YES	Both Sides	One Side	(A)
Typical		50	22	NO	Both Sides (B)	None	75
Optional							
COLLECTOR	Over 500	60	30	YES	Both Sides	One Side	(A)
Typical		60	22	NO	Both Sides (B)	None	75
Optional							

NOTE: Where streets are to serve industrial or commercial areas, the pavement design shall be based on a study prepared by the subdivider's engineer, projecting the type of vehicles using the street and traffic volumes and approved by the planning commission's engineer.

(A) Minimum as per applicable zoning ordinance requirements.

(B) Sidewalks may be permitted on only one side of the street, providing the minimum front yard depth is 75 feet and the minimum lot width is 100 feet. When subdivisions are designed to provide pedestrian walkways to the rear of lots or in other locations other than along the street, the planning commission may walve sidewalks along the street.

(C) Shoulder and side ditches may be permitted and designed in accordance with these regulations (see Appendix C) provided the minimum front yard depth is 50 feet, the minimum lot width is 100 feet, the minimum right-of-way is increased by 10 feet, except for collector streets.

(D) Individual off-street parking spaces shall be laid out in such a manner to insure that each space has unrestricted ingress and egress to a public street (i.e., not blocked from gaining access to the street via another parked vehicle).

(E) Arterial street shall be designed in a accordance with the requirements of the Kentucky Department of Transportation.

(F) Minimum pavement thickness for portland cement and asphalt concrete shall be designed in accordance with table 3 and 6, respectively.

(G) In the case where local streets serving less than 25 lots, the minimum lot width shall be as per the applicable zoning ordinance requirements.

(H) In the case of sidewalks along one side of cul-de-sac streets, sidewalks shall be extended around the cul-de-sac 4'0" back of the curb or edge of pavement to a point connecting the nearest driveway beyond the street center line as extended through the

rear of the curl-de-sac.

18 pages of exhibits